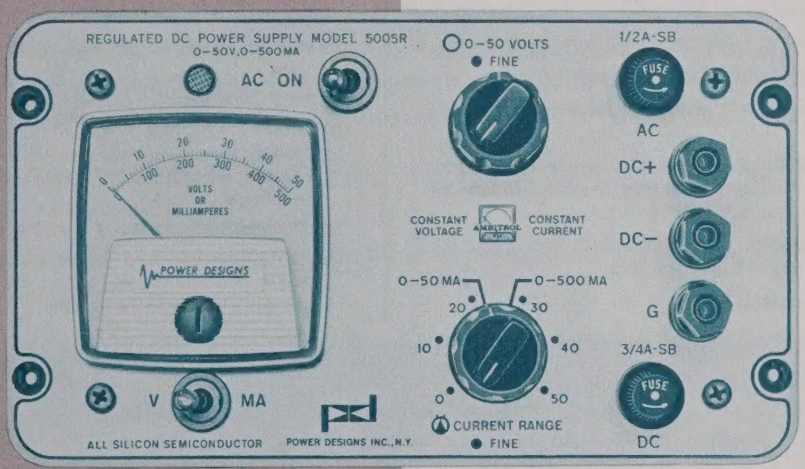
POWER DESIGNS

CONSTANT VOLTAGE–CONSTANT CURRENT POWER SOURCE

TECHNICAL DATA | MODEL 5005R



0–50 VOLTS
0–500 MA

This general-purpose instrument can supply either a constant-voltage output with continuously adjustable current limiting or a constant-current output with continuously adjustable voltage compliance. It will automatically transfer from voltage regulation to current regulation or vice versa at any predetermined operating point.

The source has two current ranges, 50 or 500 MA. When the current range is switched, the current-limit adjustment and the meter range are automatically transferred.

The output voltage and current may be remotely programmed by the connection of an external resistance to a rear-panel terminal strip. This portable instrument is ideally suited for both field and laboratory use. Its design simplicity results in a versatile unit capable of years of trouble-free service.

DESIGN FEATURES

- Dual (coarse and fine) voltage controls with 5 MV resolution.
- Dual range output-current adjustment with 250 μA resolution.
- Self-restoring electronic overload and short-circuit protection.
- All silicon-semiconductor regulator system.
- Front and rear output terminals.
- Modular construction permits multiple-unit rack mounting. One or two supplies may be mounted in a standard 5¼" x 19" rack. See catalog sheet RPA-62 for rack-panel adapters.
- Processed under Power Designs' "Predictable-Reliability" program for a 5-year MTBF. The program features: avalanche-controlled silicon rectifiers, stress-tested transistors, pre-aged zener references with extrapolated stability criteria based on $^1/f$ noise changes, computer-grade capacitors, tin-oxide-film resistors, 5 PPM sealed divider resistors, and components operated at 50% of manufacturers' published ratings. Units pre-aged under full-load conditions for a minimum of 50 hours.

ELECTRICAL SPECIFICATIONS

INPUT – 105–125 V, 55–440 Hz, 50 W*.

FRONT-PANEL OUTPUT TERMINALS – Three insulated binding posts are provided for positive output, negative output, and chassis ground. Either output terminal may be grounded or the supply output may be left floating.

REAR-PANEL OUTPUT TERMINALS – Screw terminals are provided on a phenolic terminal strip for positive output, negative output, remote voltage programming, and remote current programming.

OPERATING TEMPERATURE RANGE – 0–50°C.

CONSTANT VOLTAGE MODE

RANGE – 0–50 VDC, 0–500 MA, continuously adjustable.

REGULATION – 0.005% + 1 MV for 100% change in rated load or line variations within the operating range.

RIPPLE AND NOISE – 1 millivolt peak-to-peak, 350 microvolts rms.

RESPONSE TIME – Less than 50 microseconds for step change (1-microsecond rise time) in rated load from 10 to 100% or from 100 to 10%.

SOURCE IMPEDANCE – Less than 0.01 ohm at DC, 0.1 ohm at 20 KHz, 0.7 ohm at 1 MHz.

*at nominal line voltage.

STABILITY – Less than 0.02% + 10 MV drift per 24-hour period after warm-up, at fixed line, load, and ambient temperature, and with low TC programming resistance.

TEMPERATURE COEFFICIENT – Less than 0.02% per °C.

REMOTE PROGRAMMING RESISTANCE – 200 ohms/volt.

VOLTAGE CONTROL – Dual concentric coarse and fine adjustment with 5 MV resolution.

CONSTANT CURRENT MODE

RANGE – 0–500 MA, continuously adjustable.

VOLTAGE COMPLIANCE – 50 volts.

REGULATION – Output current change less than 500 microamps for line voltage change of ±10% or load variations down to a short circuit across the output terminals.

RIPPLE AND NOISE – Less than 300 microamps, peak-to-peak.

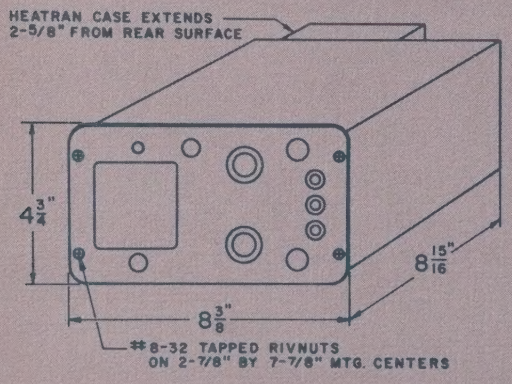
SOURCE IMPEDANCE – Greater than 100,000 ohms.

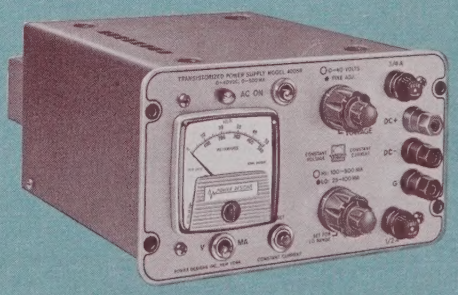
STABILITY – Less than 0.05% + 250 microamps drift per 24-hour period after warm-up, at fixed line, load, and ambient temperature, and with low TC programming resistance.

TEMPERATURE COEFFICIENT – 0.02% + 100 μA per °C.

CURRENT CONTROL – 0–50 MA and 0–500 MA, in two ranges with 0.25 MA resolution on 50 MA range and 2.5 MA resolution on 500 MA range.

DIMENSIONS





MECHANICAL SPECIFICATIONS

DIMENSIONS – 8⅜" x 4¾" x 11⅞" deep behind front panel.

WEIGHT – 8.5 pounds.

FINISH – Panel is finished in brushed, natural aluminum with etched black lettering. Housing is finished in blue-gray vinyl enamel.

PRICE **$149.50**

FOB Westbury, N. Y.

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SECTION 1
GENERAL DESCRIPTION

1-1. DESCRIPTION

The Model TW5005 power supply consists of two Model 5005R power supplies in a single assembly. The two supplies are completely independent, except for a common power transformer. All instructions in this manual apply equally to the Model 5005R and to both sections of the Model TW5005, except as specifically indicated.

Each power supply is a general-purpose transistorized DC type which may be operated as a constant-voltage source with adjustable current limiting or as a constant-current source with adjustable voltage compliance. The power supply will electronically transfer between voltage and current modes, depending upon the setting of the controls and the value of the load resistance*.

Remote resistance programming of the output voltage or current may be accomplished by simple connections to a rear-panel terminal strip.

The power supply is protected against damage from external overloads, short circuits, and reverse load currents up to one ampere.

Compact and light, the instrument is self-contained in a portable housing equipped with rubber bumper feet for laboratory bench use. Recessed dimples in the top surface permit convenient nesting of the units for maximum space utilization. Rack panel adapters are available for mounting one or two units in a standard 19-inch relay rack. The panel adapter height is 5-1/4 inches for the Model 5005R and 8-3/4 inches for the Model TW5005.

1-2. ELECTRICAL SPECIFICATIONS

Refer to Table 1 for a complete list of the electrical specifications.

1-3. OUTPUT TERMINALS

a. Front Panel: Insulated binding posts are provided for positive output, negative output, and chassis ground. Spaced on 3/4-inch centers, the terminals will accept lugs, bare wire, banana plugs, or standard multi-pin banana connectors.

b. Rear Panel: Screw terminals on a phenolic terminal strip are provided for the DC output and the external resistance programming connections.

1-4. OUTPUT POLARITY

Either the positive or negative DC output terminal may be grounded, or both terminals may be left floating. The potential between output terminals and ground should not exceed 300 volts DC. The ripple content of the constant-current output may be affected by the type or location of output grounding, due to the effective high source impedance of the supply in this mode of operation.

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* Ambitrol (R)

TABLE 1. ELECTRICAL SPECIFICATIONS

INPUT	5005R--105 to 125 V, 55 to 440 Hz, 50 watts (nominal). TW5005--105 to 125 V, 57 to 440 Hz, 90 watts (nominal).	
OPERATING TEMPERATURE	0°C to 50°C	
OUTPUT	CONSTANT VOLTAGE MODE	CONSTANT CURRENT MODE
Range	0 to 50 VDC	0 to 500 MA
Current Capacity	0 to 500 MA, max.	--
Voltage Compliance	--	0 to 50 volts
Regulation	*Front Terminals: 0.005% + 1 MV Rear Terminals: 0.01% + 3 MV For 100% change in rated load, or line variations within the operating range.	Output current change less than 500 μA for line voltage change of ± 10% or load variations down to a short circuit across the output.
Ripple and Noise	1 MV, peak-to-peak	Less than 300 μA, peak-to-peak
Temperature Coefficient (TC)	Less than 0.02% /°C	Less than 0.02% + 100 μA per °C
Stability	Less than 0.02% +10 MV drift per 24-hr. period after warm-up, with fixed line, load and ambient temperature, and with low TC external programming resistor.	Less than 0.05% + 250 μA drift per 24-hr. period after warm-up, with fixed line, load and ambient temperature, and with low TC external programming resistor.
Source Impedance	Less than 0.1 ohm to 20 KHz Less than 0.7 ohm to 1 MHz	Greater than 100,000 ohms.
Remote Programming Constant	200 ohms/volt	See paragraph 2-5.
Resolution	Coarse and fine voltage controls with better than 5 MV resolution	0-50 MA and 0-500 MA in two ranges with 0.25 MA resolution on 50 MA range and 2.5 MA on the 500 MA range.
Recovery Time	Less than 50 usec for a 1 usec (rise time) step change in rated load from 10% to 100% or vice versa.	

* Model TW5005 has 0.005% + 1 MV regulation at both front and rear terminals.

1-5. METERING

A single meter with dual scales, and a function selector switch, permits monitoring of either output voltage or current.

1-6. CIRCUIT PROTECTION

The AC line and DC load circuits are separately fused. The maximum output current of the supply is electronically limited to approximately 550 milliamperes. The DC fuse will blow in the event of an internal circuit failure which results in excessive internal or external load currents.

1-7. MECHANICAL SPECIFICATIONS

a. Dimensions: Model 5005R -- 8-3/8 inches wide by 4-3/4 inches high by 11-9/16 inches deep behind front panel. Model TW5005 -- 7-3/4 inches wide by 8-5/8 inches high by 13-1/16 deep behind front panel.

b. Finish: The panel is finished in brushed, anodized, natural aluminum with etched black lettering. The housing is finished in blue-gray vinyl enamel.

c. Weight: Model 5005R -- 8.5 pounds. Model TW5005 -- 17.5 pounds.

SECTION 2
INSTALLATION AND OPERATION

2-1. INSTALLATION

a. Laboratory Bench: The Models 5005R and TW5005 are portable units designed for bench use. No preliminary processing or unpacking procedures are required. The power supplies are ready for operation as shipped from the factory.

b. Rack Mounting: Panel adapters are available for mounting one or two units in a standard 19-inch relay rack. Hardware kits are provided with each panel adapter. The supply is fastened to the rear surface of the panel adapter by means of the black anodized rivnuts in each corner of the power supply panel. If the rubber bumper feet interfere with the assembly of the equipment to the rack, they can be removed by disassembling the power-supply bottom plate and unscrewing them on the Model 5005R, or by removing the housing and unscrewing them on the Model TW5005.

2-2. CONSTANT-VOLTAGE OPERATION

a. Voltage Adjustment:

(1) Rotate the FINE current control fully counterclockwise.

(2) Rotate the 0-50 VOLTS control fully counterclockwise.

(3) Set the AC ON toggle switch in its off position. Connect the power cord into a convenient source of 115 VAC, 57 to 440 Hz.

(4) Set the toggle switch to AC ON. The neon pilot indicator should illuminate.

(5) Set the meter function switch to V and adjust the 0-50 VOLTS and FINE controls to the desired output voltage. The FINE control has a range of approximately 0.5 volt. It permits setting the output voltage with a resolution of better than 5 millivolts.

NOTE

When the voltage and current controls are turned fully counterclockwise, the output voltage will go through zero and reverse approximately 0.5 volt. Under these conditions a maximum load current of 3 milliamperes can flow through the load.

b. Output Current Limiting:

(1) Set the toggle switch to its off position.

(2) Connect a jumper wire across the output terminals.

(3) Set the toggle switch to AC ON and the meter function switch to MA.

(4) Set the CURRENT RANGE control to the desired current range and adjust the FINE current control to the desired current-limit level.

(5) Set the toggle switch to its off position.

(6) Remove the jumper wire from the output terminals.

(7) Connect the external load to the front-panel binding posts or to the rear-panel terminals marked DC+ and DC-.

(8) If desired, connect a jumper wire from either output terminal to the G (chassis ground) terminal on the front panel.

(9) Set the toggle switch to AC ON.

c. Output Current Limiting (Alternate Method): An alternate, but less-accurate, method of current limiting may be employed when a load is connected to the output terminals.

(1) Set the power switch to AC ON and the meter function switch to V.

(2) Rotate the FINE current control counterclockwise from its maximum position until the meter reading just starts to drop.

(3) Rotate the FINE current control clockwise from this threshold (voltage-to-current transfer) point to the approximate current-limiting point desired.

2-3. CONSTANT-CURRENT OPERATION

a. Current Adjustment:

(1) Rotate the 0-50 VOLTS and FINE voltage controls fully clockwise.

(2) Set the CURRENT RANGE control to the desired current range and the FINE current control fully counterclockwise.

(3) Connect a jumper wire across the output terminals.

(4) Set the toggle switch to AC ON.

(5) Set the meter function switch to A and adjust the FINE current control to the desired output current.

(6) Set the toggle switch to its off position.

(7) Remove the jumper wire and connect the external load to either the front-panel or rear-panel DC+ and DC- terminals.

(8) If desired, connect a jumper wire from either output terminal to the G (chassis ground) terminal on the front panel.

(9) Set the toggle switch to AC ON.

NOTE

The constant-current supply is effectively a high-impedance source. The electrostatic (capacitive) relationship of the source and the load to external grounds and/or the AC line may affect the ripple component of the output current. Reversing the AC line cord to the supply, experimentally selecting an optimum ground point at the load, or floating the power supply output terminals may minimize the ripple component.

b. Voltage Limiting: With the voltage controls set fully clockwise, the maximum compliance voltage of the supply is approximately 51 volts. If it is desired to limit the maximum output voltage of the supply below this value, proceed as follows:

(1) Set the toggle switch to its off position and remove the load from the supply.

(2) Set the meter function switch to V and the toggle switch to AC ON.

(3) Adjust the 0-50 VOLTS and FINE voltage controls to the desired maximum compliance value (as indicated on the front-panel meter).

(4) Connect the load to the supply and set the toggle switch to AC ON.

2-4. REMOTE VOLTAGE PROGRAMMING

The output voltage can be programmed remotely by an external fixed or variable resistance. For remote programmed constant voltage, proceed as follows:

a. Set the toggle switch to its off position.

b. Remove the link between screw terminals RV1 and RV2 on the rear-panel terminal strip.

c. Select the required resistance by multiplying the required value of voltage by 200 (programming constant is approximately 200 ohms per volt). The resistance may have to be trimmed slightly to produce the exact output voltage required. A constant current of 5 milliamperes will flow through this resistance, and its wattage rating should be chosen to minimize drift due to heating effects.

d. Connect the external programming resistance between the RV1 and DC- terminals.

e. Set the toggle switch to AC ON.

CAUTION

If the remote programming connections are opened while the supply is operating, the output voltage will rise to the maximum compliance of the supply (over 50 volts). When a switch is used to select resistors for output-voltage programming, it should have shorting-type contacts, to avoid voltage spikes.

2-5. REMOTE CURRENT PROGRAMMING

The output current can be programmed remotely by employing external fixed or variable resistance. For remote programmed constant current, proceed as follows:

a. Set the toggle switch to its off position.

b. Rotate the FINE current control fully clockwise. (This control will be in parallel with the external programming resistor and will affect the current output if not left in this position.)

c. Select the required resistance by using the following relationships:

With the CURRENT RANGE switch set to 0-500 MA:

$$R = \frac{215 \times I}{540 \times I}$$

With the CURRENT RANGE switch set to 0-50 MA:

$$R = \frac{21.5 \times I}{54 - I}$$

Where I = desired output current in milliamperes

R = remote programming resistance in ohms.

d. Connect the external programming resistance between the RC and DC+ terminals on the rear-panel terminal strip.

e. Set the toggle switch to AC ON.

2-6. ELECTRONIC VOLTAGE-CURRENT OR CURRENT-VOLTAGE CROSSOVER

The Model 5005R can switch electronically from a constant-voltage source to a constant-current source or vice versa. The power supply can be adjusted to switch at any voltage or current in its operating range. Proceed as follows to set the switching point for either direction of crossover (constant voltage to current or current to voltage).

a. Check that the toggle switch is off and remove the load from the power supply.

b. Set the CURRENT RANGE switch to 0-500 MA and the FINE current control completely clockwise.

c. Set the toggle switch to AC ON and adjust the 0-50 VOLTS and FINE voltage controls to the desired voltage crossover point.

d. Set the toggle switch to its off position and connect a jumper wire across the output terminals.

e. Set the toggle switch to AC ON and the meter function switch to MA.

f. Set the CURRENT RANGE control to the desired current range and adjust the FINE current control to the desired crossover point.

g. Set the toggle switch to its off position and connect the load.

h. Set the toggle switch to AC ON. The power supply will function as a constant-voltage source when the product of the load resistance and the constant current is less than the preset voltage. The supply will function as a constant-current source when the product of the load resistance and the preset current is greater than the preset voltage. The power supply will automatically switch back and forth to either mode of operation, depending upon the load resistance value. In the crossover region, the output voltage will not change more than 0.1% or 50 millivolts from its preset value; the output current will not change more than 0.1% or 500 microamperes from its preset value. In the regions beyond the crossover area, the voltage or current regulation will be within the rated specifications for that mode of operation.

2-7. SERIES OPERATION

a. Constant Voltage: As many as eight Model 5005R units may be operated in series to provide up to 400 volts. In series operation, the CURRENT RANGE and FINE current controls on all units should be set completely clockwise. The ground terminals on all units may be left floating or may be connected together and tied to either the most negative or positive output terminal. After the units are connected together, proceed as directed in paragraph 2-2, except adjust current limiting as indicated in paragraph b below.

b. Current Limiting or Constant Current: The Model 5005R may be operated as a constant-voltage source with current limiting or as a constant-current source with voltage compliance when connected in series. However, each power supply connected in series operates independently as far as electronic crossover from voltage regulation to current regulation is concerned. A typical example is that of two supplies connected in

series, each adjusted for a 40-volt, 100-milliampere output. With a resistive load slightly less than 800 ohms, only one of the supplies will automatically crossover into the constant-current mode. The power supply which first switches into the constant-current mode will provide constant current, the other supply will continue acting as a constant voltage source. As the load resistance continues to decrease, the power supply in the constant-current mode will maintain stable output current until it reaches zero output voltage. With a further decrease in load resistance, the voltage across this supply reverses. An internally connected silicon power diode (CR15), shunted across the output terminals (normally non-conductive), becomes conductive and carries the load current around this unit. At this point, the power supply in its constant voltage mode will crossover into the constant current mode and maintain the output current at its own current setting.

If desired, output current settings of both power supplies may be set to two distinct values to provide a discrete shift to a new current level. Similarly, a number of supplies connected in series will crossover automatically to constant-current operation in the sequential order of the lower preset current levels.

2-8. PARALLEL OPERATION

Two units may be operated in parallel to obtain up to one ampere as follows:

a. Turn on the supplies and set them for the desired output voltage compliance.

b. Set the CURRENT RANGE controls on both power supplies to the 0-500 MA positions.

c. Adjust each FINE current control to 500 milliamperes.

d. Connect the DC+ output terminals together.

e. Connect a 0 to 10 MA meter between the two DC- output terminals.

f. Adjust the voltage controls of one supply until the milliammeter indicates zero.

g. Disconnect the milliammeter and connect the negative terminals together.

h. Connect the load to the power supplies. The power supplies furnish current to the load sequentially. For currents from 0 to 500 milliamperes, one supply will function as the current source. Beyond this point, the second supply will provide current to the load, up to a maximum total current of 1 ampere.

SECTION 3
PRINCIPLES OF OPERATION

3-1. GENERAL

The Model 5005R and each source in the Model TW5005 is a transistorized voltage or current-regulated DC power type. It employs two regulator-control amplifiers; one for constant output voltage and the other for constant output current. The two are mutually exclusive; when one amplifier is functioning the other is automatically cutoff.

The regulator circuit is of the series type -- an electronically variable resistance interposed between an unregulated source and a load. The resistance value is controlled by an amplifier which compares the supply-output voltage with a reference voltage and adjusts the series resistance to reduce the error signal toward zero. The series resistance is controlled by one of two amplifiers; one used for constant-voltage output and the other for constant-current output.

The constant-voltage amplifier compares a portion of the output voltage with the reference voltage. The reference voltage is generated by an internal, regulated auxiliary-power source. The error signal resulting from the voltage comparison is amplified and applied through a driver stage to the series transistor to vary its effective resistance.

Similarly, the constant-current amplifier compares the reference voltage with the voltage across a resistance in series with the supply output. The error signal resulting from this comparison is amplified and applied through a driver stage to the series transistor to maintain the voltage drop across the series resistance equal to the reference voltage. The reference voltage is adjusted for the desired output current.

NOTE

The circuit numbers used to identify the electrical components of the Model TW5005 are duplicated for corresponding components in each of its two sources. The same circuit numbers are used to identify the corresponding components of the Model 5005R.

3-2. SERIES-REGULATOR OPERATION

During constant-voltage operation, transistors Q8 and Q9 function as the voltage-comparator amplifier. The voltage reference is taken from the auxiliary supply which is connected in series with the main supply and the output-voltage divider. The output-voltage divider consists of 0-50 VOLTS control R32, FINE voltage control R33, R46, and R47. Resistor R45 and diode CR8 are a temperature-compensation network. Rheostat R47 sets the current through the voltage divider at approximately 5 milliamperes. Any change in output voltage changes the current through the voltage-divider resistance and the base current of Q9.

For example, when the output voltage starts to rise, the emitter potential of Q9 rises while the base potential rises only slightly, reducing the forward bias on this stage. The resulting fall in collector current in Q9 increases the forward bias of amplifier Q8. The heavier Q8 collector current increases the forward bias of amplifier Q5. The higher Q5 collector current increases the forward bias of amplifier Q4, reducing

the base current of driver Q3. The lowered collector current of Q3 reduces the forward bias of series transistor Q2, increasing its voltage drop or its effective resistance, and therefore reducing the output voltage.

Constant-current amplifier Q6 compares the voltage drop across series resistors R14 through R17 and R48 with a reference voltage obtained from the auxiliary supply through divider R25, R26, and R27. The voltage drop across the series resistors increases as the power-supply-output current increases. Rheostat R27 is adjusted so that Q6 is biased into cut-off at currents below the value set by FINE potentiometer R25. When current-range switch S3 is set to the 0-500 MA position, it shorts out all current-sensing resistors except R14 and R17. Diode CR14 provides temperature compensation for Q6.

When the voltage drop across the sensing resistors due to output current exceeds the value set by FINE potentiometer R25, Q6 will be forward biased. The resulting Q6 collector current forward biases Q7. The Q7 collector current increases the drive of amplifiers Q5 and Q4. The increased collector current of amplifier Q4 reduces the forward bias of driver Q3, reducing the collector current of this stage and consequently of series transistor Q2.

The voltage-comparator amplifier circuit opposes the reduction of output voltage. The collector current of amplifier Q9 increases as the output voltage decreases. The resulting decrease in Q8 collector current reduces the base current of Q5, offsetting the base current increase from the constant-current amplifier. As the output current increases, Q9 goes to saturation and Q8 is cut-off. The constant-voltage circuit is disabled at this point and the constant-current amplifier controls the supply output. The power supply operates in this mode until load resistance increases to the point where the voltage drop across the current sensing resistors due to load current is insufficient to keep Q6 forward biased. When the current falls below this level, Q6 becomes cut-off, Q9 leaves saturation, and Q8 leaves cut-off. The constant-current circuit is then disabled, and the voltage-comparator amplifier controls the power supply output.

3-3. POWER DISSIPATION SHIFT CIRCUITRY

The Model 5005R incorporates the patented HEATRAN® power dissipation shift circuitry. This circuitry transfers the power normally dissipated in the series transistor to an externally mounted power resistor. The circuitry consists basically of Q1, R3, and CR10, which maintain the voltage drop across Q2 below a preset value. Normal operating bias for Q1 and Q2 is obtained from the auxiliary power supply. The voltage drop across series transistor Q2 is compared with a 5.5-volt reference from zener diode CR10. At low line voltage, the collector-emitter voltage drop across Q2 (minus the V_{BE} of Q1 and the forward drop of CR9) is below the reference value, Q1 is forward biased into saturation, and most of the output current flows through it. As the line voltage increases, the voltage drop across Q2 approaches the reference voltage. Zener diode CR10 then fires, bypassing a portion of Q1 base current. This reduces the forward bias of Q1 decreasing its collector current and diverting more output current through R3. Resistor R3 is a vitreous-enamel power type in a cage at the rear of the power supply.

At maximum line voltage, Q1 is cut off and the drop across Q2 is approximately 4.5 volts (a dissipation of 2.25 watts). The dissipation in R3 at this time is approximately 35 watts. Therefore, at maximum line voltage, the power dissipated in the series transistor is only a fraction of that in a conventional power supply. The power normally dissipated in the series transistor has thus been transferred to externally mounted resistor R3. HEATRAN® circuitry permits fewer power transistors for a given power-supply capacity, a more compact equipment, increased reliability, and simple equipment temperature control.

3-4. METER CIRCUITRY

The meter circuitry consists of meter M1, CURRENT RANGE switch S3, shunt resistors R16, R17, and R48, meter-calibration resistor R28, and Q4 with its associated components. CURRENT RANGE switch S3 selects the meter-shunt resistors used on the two meter scales. When this switch is set to the 0-50 MA position, all shunt resistors are in the circuit and resistor R48 trims the shunt resistance to provide full-scale meter deflection at exactly 50 milliamperes.

When meter-function switch S2 is set to the V position, resistor R28 sets the meter current to give an exact, full-scale deflection at a power-supply output of 50 volts. To keep the meter reading zero with no load on the supply, transistor Q14 is connected between the positive DC output of the main supply and the negative return of the auxiliary supply. Rheostat R39 is adjusted so that the currents of the output voltage and current dividers are diverted through Q14 and not through the meter.

3-5. AUXILIARY-SUPPLY OPERATION

The series-regulated auxiliary supply consists basically of amplifiers Q13 and Q12, driver Q11 and series transistor Q10. A sample of the output voltage from this supply is taken from the junction of resistors R43 and R44 and applied to the base of amplifier Q13. This potential, together with the emitter potential applied from zener diode CR7 sets the base-emitter bias on this stage. Any change in output voltage changes the bias of Q13, changing the base current of Q12. The Q12 collector current controls the base-emitter bias of driver Q11 whose collector current, in turn, controls the effective resistance of series transistor Q10.

For example, if the output voltage increases, the forward bias of Q13 is increased, and the resulting increased collector current of this stage increases the base current of Q12. Increased collector current of Q12 increases the forward bias of Q11. The resulting increase in Q11 collector current reduces the base current of series transistor Q10, increasing its effective resistance and decreasing the supply output voltage.

SECTION 4
MAINTENANCE

4-1. GENERAL

Under normal conditions, no special maintenance required. In the event of improper functioning of the supply, certain precautions must be observed in repair and maintenance. Since transistorized high-gain, closed-loop DC amplifiers are employed, use care to avoid the possibility of chain-reaction transistor burnouts. Read the following data thoroughly before starting to repair the power supply.

a. Schematic Diagram: The schematic diagram included in the Appendix gives complete voltage information and operating potentials of the power-supply circuit. Two voltage measurements are given; one during the constant-voltage mode, and the other (shown in brackets) during the constant-current mode.

b. Component-Location Diagram: A drawing of the control-amplifier terminal board showing component location on the front and rear surfaces is included on the schematic diagram. It can assist in locating components during maintenance.

c. General Maintenance: The most rapid method of isolating circuit faults is that of voltage measurements across the component parts. Using the voltage measurements given on the schematic diagram should constitute the first step in servicing the supply.

CAUTION

When unsoldering semiconductors for test, use a heat sink to avoid thermal damage. A long-nose pliers between the semiconductor and the solder junction is adequate. Never operate the power supply with any leads disconnected or semiconductors removed from the circuit. Proper operating potentials in DC amplifiers may change radically when a component is removed or disconnected, resulting in possible chain-reaction burn-outs.

4-2. GENERAL TROUBLE SYMPTOMS AND SUGGESTED PROCEDURES

a. Power Supply Does Not Go On: Check the panel fuses, and then check for AC line voltage across terminals 1 and 2 of T1. If the AC fuse (F1) blows repeatedly, check diodes CR1 through CR4. Use an ohmmeter to take a resistance reading, and then reverse the meter leads to take another resistance reading. If one reading is not at least 5 times the other, the diode is defective. Diodes CR1 and CR2 in the main regulator or CR3 and CR4 in the auxiliary regulator should be replaced as a pair. A short circuit in one will produce heavy surge currents in the other, possibly producing junction damage.

b. No DC Output Voltage: Check for proper potentials across C1, C6, and C2. If the front-panel meter reads full scale with the meter selector set to MA and the FINE current control completely clockwise, check safety diode CR17 for a short circuit.

Transistorized power supplies are extremely sensitive to potentials applied to their output terminals in excess of the adjusted output voltage or in reverse polarity to the output voltage, regardless of whether the power supply is turned on. The output electrolytic capacitors (C12 or C13) can be readily damaged by reverse potentials. Also, the voltage-sensing transistors may see excessive or reverse potentials applied to the base-emitter junctions. This may result in permanent damage. The safety diode across the output terminals protects against reverse potentials. In the event of reverse polarity potentials applied to the output terminals, this diode limits the reverse potential to approximately 1 volt. The capacity of this diode is 750 milliamperes. In the event of higher reverse current flow, the diode may weld, resulting in a permanent short circuit. This prevents further damage to the power supply, and normal operation can be restored by replacing the diode.

c. Failure to Regulate in Either Voltage or Current Mode: Check for proper potentials on amplifier transistors, voltage reference, etc. Use the voltages given on the schematic diagram. If any voltage appears incorrect, set the toggle switch to its off position and make a rapid check for defective transistors. This check can be made without removing the transistors from the circuit. Use an ohmmeter set to its low resistance scale (R x 1). Measure the forward and reverse resistances of the collector-base, base-emitter, and collector-emitter junctions. A resistance ratio of less than 5 to 1 will indicate a defective item. If a transistor appears defective, remove it carefully and check it on a good transistor tester. This same technique may be applied to rectifiers and zener diodes.

d. Poor Regulation, High Ripple Output: No specific check can be suggested, since failure to regulate within specifications may be caused by any component in the system. Make a point-to-point voltage and resistance check. Check all capacitors for opens and electrolytic capacitors for excessive leakage. Make stage-gain measurements by changing the output load current and noting the change in base current in each amplifier stage. Use low-resistance milliammeters and microammeters to avoid upsetting the regulator. The open-loop current gain of the regulator system should not be less than 10^6 from the base current of the input comparator to the collector current of Q2. It may be desirable to open the collector lead of Q6 when checking the voltage regulator or of Q9 when checking the current regulator to avoid interaction.

4-3. ADJUSTMENT AND CALIBRATION

Perform the following procedures whenever a component is replaced or periodic recalibration is scheduled. Perform the procedures in the order given.

a. Preliminary Meter Adjustment:

(1) Mechanically zero the meter using the adjustment screw on its front panel.

NOTE

Before completing any meter adjustment, lightly tap the meter face. This will overcome any pivot friction and insure proper calibration.

(2) Set the FINE current control completely clockwise.

(3) Set the meter function switch to MA.

(4) Set the CURRENT RANGE switch to 0-50 MA.

(5) Ensure that no load is connected to the power supply.

(6) Set the toggle switch to AC ON.

(7) Adjust potentiometer R39 (on the amplifier board) for a panel meter indication of zero.

(8) Set the toggle switch to its off position.

b. Output-Voltage Adjustment:

(1) Rotate the 0-50 VOLTS and FINE current controls completely clockwise.

(2) Rotate the FINE voltage control completely counterclockwise.

(3) Connect an accurate (1% or better) voltmeter between the front panel DC+ and DC- terminals.

(4) Set the toggle switch to AC ON and allow a 10-minute warm-up period.

(5) Adjust potentiometer R47 on the amplifier board until the output voltage is exactly 50 volts as indicated on the voltmeter.

(6) Set the toggle switch to its off position.

c. Current-Limit Calibration:

(1) Rotate the 0-50 VOLTS and FINE voltage controls completely clockwise.

(2) Set the CURRENT RANGE switch to 0-500 MA.

(3) Connect an accurate (1% or better) DC milliammeter (set to read 500 MA) between the front-panel DC+ and DC- terminals.

(4) Set the toggle switch to AC ON and allow a 10-minute warm-up period.

(5) Set the FINE current control to 50.

(6) Adjust potentiometer R27 (on the amplifier board) for an output current of 500 milliamperes as indicated on the milliammeter.

(7) Adjust the FINE current control until the output current is zero as indicated on the milliammeter. If necessary, loosen the knob of the FINE current control and align its index mark with the zero mark on the panel.

(8) Repeat paragraphs (5) through (7) above until no further adjustments are necessary.

(9) Set the toggle switch to off.

d. Meter Calibration:

(1) Connect a DC milliammeter set to read 500 milliamperes between the front-panel DC+ and DC- terminals.

(2) Set the CURRENT RANGE switch to 0-500 MA.

(3) Set the toggle switch to AC ON.

(4) Adjust the FINE current control for a 500-milliampere indication on the milliammeter.

(5) Adjust potentiometer R28 (on the meter board behind the meter) for an indication of 500 MA on front-panel meter.

(6) Set the toggle switch to its off position.

(7) Set the DC milliammeter to read 50 milliamperes and the CURRENT RANGE switch to 0-50 MA.

(8) Set the toggle switch to AC ON.

(9) Adjust the FINE current control for a 50-milliampere indication on the DC milliammeter.

(10) Adjust rheostat R48 (on the meter board behind the meter) for a 50-milliampere indication on the front-panel meter.

(11) Set the toggle switch to its off position and disconnect the DC milliammeter.

SECTION 5
APPENDIX

5-1. INTRODUCTION

This appendix contains an electrical parts list, a schematic and parts-location diagram, and an equipment warranty.

5-2. ELECTRICAL PARTS LIST

NOTE

The circuit numbers used to identify the electrical components of the Model TW5005 are duplicated for corresponding components in each of its two sources. The same circuit part numbers are used to identify the corresponding components of the Model 5005R. All differences between parts of the two models are indicated in the Electrical Parts List.

All electrical and electronic parts are listed in the sequence of their circuit numbers, as shown on the schematic diagram. A brief description of each part is given, followed by the code number of the manufacturer and his part number. All manufacturers' code numbers are taken from Cataloging Handbooks H4-1 and H4-2, Federal Supply Code for Manufacturers. These handbooks are available through Federal Agencies. They may also be ordered directly from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

It is recommended that all parts having the code number 98095 be ordered directly from Power Designs, Inc. The commercial equivalents of these parts have either wide parameter tolerances or require special factory inspection or modification before they are suitable for use in the power supply.

All components used in the power supply, or supplied as replacements, are carefully inspected at the factory. Inspections are performed on a 100% basis or at AQL levels in accordance with Military Specification MIL-Q-9858, under which Power Designs, Inc. has been qualified.

All semiconductors are inspected on a 100% basis. They are inspected not only for operating parameters, but also for critical characteristics related to reliability and predictable life expectancy. Some of these characteristics are observed when the device is taken beyond its normal operating regions. These test techniques have been developed under a "predictable-reliability" program in operation at Power Designs, Inc. for the past ten years. Under this program, quality-control procedures are constantly reevaluated and updated as new advances are made in solid-state technology and additional experience is gleaned from field history.

Semiconductor manufacturers are constantly modifying their products. Complete lines are frequently discontinued, to be replaced by devices having improved gain, operating voltage levels, and frequency response. The high-gain, closed-loop DC amplifiers used in regulator circuits are particularly sensitive to even slight changes in these parameters. Commercial or military "equivalent" transistors used as replacements may

affect the power supply performance. Compliance with the original specifications can be assured if replacement semiconductors are ordered from the factory.

All replacement semiconductors are processed and stocked at the factory to insure complete interchangeability with the devices in the original equipment. To insure that proper replacements are provided, the original devices are coded with a Power Designs, Inc. part number as follows:

FS	696	A
Semiconductor manufacturer's code	Power Designs, Inc. type	Suffix identifying special parameters

When ordering replacements, please identify the device as completely as possible, listing the model and serial number if available.

In some cases, the replacement part received may have a different part number from that given in the electrical parts list. This can be due to several factors:

a. A different prefix indicates that Power Designs, Inc. is using a different vendor source. The operating characteristics of the devices are identical.

b. A completely different part number may indicate:

(1) The original vendor discontinued manufacture of the item or could no longer manufacture it to the original specifications.

(2) A better device for use in the particular circuit has been substituted.

(3) Tighter controls for interchangeability have provided greater assurance of improved reliability with the new replacement.

ELECTRICAL PARTS LIST

NOTE

When replacing semiconductors or investigating their part numbers, note the information presented in paragraph 5-2, above.

Circuit Number	Description	Mfr. Code No.	Part Number
C1	*Capacitor, electrolytic, 350 uf, 85 vdc	98095	CE-47-.85LT
	**Capacitor, electrolytic, 400 uf, 85 vdc	98095	CE-83-.85
C2	*Capacitor, electrolytic, 1000 uf, 25 vdc	98095	CE-72-.25LT
	**Capacitor, electrolytic, 1200 uf, 30 vdc	98095	CE-109-.3
C3	Capacitor, plastic film, 0.1 uf, 200 vdc	98095	CP-17-2
C4	Capacitor, plastic film, 0.01 uf, 200 vdc	98095	CP-16-2
C5	Capacitor, electrolytic, 4.7 uf, 35 vdc	98095	CE-34-.35
C6	Capacitor, electrolytic, 20 uf, 100 vdc	98095	CE-103-1
C7	Capacitor, ceramic disc, 0.005 uf, 1000 vdc	98095	CC-30-10
C8	Capacitor, plastic film, 0.001 uf, 200 vdc	98095	CP-24-2

*Model 5005R only.
**Model TW5005 only.

ELECTRICAL PARTS LIST (cont'd)

Circuit Number	Description	Mfr. Code No.	Part Number
C9	Capacitor, electrolytic, 4.7 uf, 35 vdc	98095	CE-34-.35
C10	Capacitor, plastic film, 0.01 uf, 200 vdc	98095	CP-16-2
C11	Capacitor, plastic film 0.0047 uf, 200 vdc	98095	CP-26-2
C12	*Capacitor, electrolytic, 50 uf, 50 vdc	98095	CE-75-.5
	**Capacitor, electrolytic, 51 uf, 50 vdc	98095	CEX-51-50
C13	*Capacitor, electrolytic, 50 uf, 50 vdc	98095	CE-75-.5
C14	Capacitor, electrolytic, 8 uf, 100 vdc	98095	CE-42-1
C15	Capacitor, plastic film, 0.01 uf, 200 vdc	98095	CP-16-2
CR1 thru CR4	Diode, silicon, rectifier	98095	PR200
CR5, CR6	Diode, silicon, rectifier	98095	ED3002B
CR7	Diode, silicon, zener	98095	WZ734B
CR8, CR9	Diode, silicon, rectifier	98095	ED3002B
CR10	Diode, silicon, zener	98095	AC359E or F
CR11	Diode, silicon, zener	98095	DE310C or DE410***
CR12 thru CR17	Diode, silicon, rectifier	98095	ED3002B
F1	*Fuse, 1/2 ampere, "Slo-Blo"	71400	Type MDL
	**Fuse, 1 1/2 ampere, "Slo-Blo"	71400	Type MDL
F2	*Fuse, 3/4 ampere, "Slo-Blo"	71400	Type MDL
	**Fuse, 1 ampere, "Slo-Blo"	71400	Type MDL
I1	Pilot light assembly	98095	PLA-3
M1	Volt-ammeter, 0-50V, 0-50 MA and 0-500 MA	98095	MVA-110
Q1, Q2	*Transistor, silicon, NPN	98095	RC3069A
	**Transistor, silicon, NPN	98095	SD1700
Q3	Transistor, silicon, NPN	98095	RC2270
Q4	Transistor, silicon, NPN	98095	GI696 or MS696
Q5, Q6	Transistor, silicon, PNP	98095	MS1028A
Q7, Q8	Transistor, silicon, NPN	98095	GI696 or MS696
Q9	Transistor, silicon, NPN	98095	AS0697A or GI696A
Q10	Transistor, silicon, NPN	98095	RC2270
Q11	Transistor, silicon, NPN	98095	GI696 or MS696
Q12	Transistor, silicon, PNP	98095	MS1028A
Q13, Q14	Transistor, silicon, NPN	98095	GI696 or MS696
R1	Resistor, composition, 47 kΩ ±10%, 1 w	01121	GB4731
R3	Resistor, wirewound, 125 Ω ±5%, 45 w	98095	RWF-1250-P3
R4	Resistor, wirewound, 200 Ω ±5%, 3 w	98095	RW-201-3K
R5	Resistor, wirewound, 100 Ω ±5%, 5 w	98095	RW-101-3D
R6	Resistor, composition, 220 Ω ±10%, 1/2 w	01121	EB2211

*Model 5005R only.
**Model TW5005 only.
***If type DE310C is used, R6 must be 150 Ω ±10%, 1/2 w, 01121 type EB1511.

ELECTRICAL PARTS LIST (cont'd)

Circuit Number	Description	Mfr. Code No.	Part Number
R8	Resistor, composition, 330 Ω ±10%, 1/2 w	01121	EB3311
R9	Resistor, composition, 1.2 kΩ ±10%, 1/2 w	01121	EB1221
R10	Resistor, composition, 470 Ω ±10%, 1/2 w	01121	EB4711
R11	Resistor, composition, 2.7 kΩ ±10%, 1/2 w	01121	EB2721
R12	Resistor, composition, 750 Ω ±5%, 1/2 w	01121	EB7515
R13	Resistor, composition, 1 kΩ ±10%, 1/2 w	01121	EB1021
R14	Resistor, wirewound, 3 Ω ±5%, 3 w	98095	RW-030-3KA
R15	Resistor, wirewound, 27 Ω ±5%, 3 w	98095	RW-270-3KA
R16	Resistor, wirewound, 3 Ω ±5%, 3 w	98095	RW-030-3KA
R17	Resistor, meter shunt, 0.20 Ω	98095	RW-FA-5A
R18	Resistor, composition, 5.6 kΩ ±10%, 1/2 w	01121	EB5621
R19	Resistor, composition, 1.5 kΩ ±10%, 1/2 w	01121	EB1521
R20	Resistor, composition, 1.2 kΩ ±10%, 1/2 w	01121	EB1221
R21	Resistor, composition, 5.6 kΩ ±10%, 1/2 w	01121	EB5621
R22	Resistor, composition, 1.5 kΩ ±10%, 1/2 w	01121	EB1521
R23	Resistor, composition, 2 kΩ ±5%, 1/2 w	01121	EB2025
R24	Resistor, composition, 1 kΩ ±10%, 1/2 w	01121	EB1021
R25	Potentiometer (part of S3), 200 Ω ±10%, 2 w	98095	PS-5005R-12
R26	Resistor, composition, 910 Ω ±5%, 1/2 w	01121	EB9115
R27	Potentiometer, wirewound, 500 Ω ±10%, 1-1/4 w	98095	RWT-501-C4
R28	Potentiometer, wirewound, 50 Ω ±10%, 1-1/4 w	98095	RWT-500-C4
R29	Resistor, precision, 49.9 kΩ ±0.5%, 1/2 w	16299	Type NA60
R30	Resistor, composition, 150 Ω ±10%, 1/2 w	01121	EB1511
R31	Resistor, composition, 9.1 kΩ ±5%, 1/2 w	01121	EB9125
R32, R33	Potentiometer, wirewound, dual tandum, 10 kΩ ±5%, 3 w and 100 Ω ±10%, 3 w	98095	RWVT5807
R34	Resistor, composition, 5.6 Ω ±10%, 1/2 w	01121	EB56G1
R35	Resistor, composition, 180 Ω ±10%, 2 w	01121	HB1811
R36	Resistor, composition, 100 Ω ±10%, 1/2 w	01121	EB1011
R37	Resistor, composition, 680 Ω ±10%, 1/2 w	01121	EB6811
R38	Resistor, composition, 330 Ω ±10%, 1/2 w	01121	EB3311
R39	Potentiometer, wirewound, 25 Ω ±10%, 1-1/4 w	98095	RWT-250-C4
R40	Resistor, composition, 10 Ω ±10%, 1/2 w	01121	EB1001
R41	Resistor, composition, 6.8 kΩ ±10%, 1/2 w	01121	EB6821
R42	Resistor, composition, 390 Ω ±10%, 1/2 w	01121	EB3911
R43	Resistor, wirewound, 500 Ω ±5%, 3 w	98095	RW-501-3KA
R44	Resistor, wirewound, 700 Ω ±5%, 3 w	98095	RW-701-3KA
R45	Resistor, composition, 30.1 kΩ ±1%, 1/4 w	16299	Type NA60
R46	Resistor, wirewound, 2.2 kΩ ±5%, 3 w	98095	RW-222-3KA

ELECTRICAL PARTS LIST (cont'd)

Circuit Number	Description	Mfr. Code No.	Part Number
R47	Potentiometer, wirewound, 500 Ω ±10%, 1-1/4 w	98095	RWT-501-C4
R48	Potentiometer, wirewound, 25 Ω ±10%, 1-1/4 w	98095	RWT-250-C4
R49	Resistor, composition, 1.2 kΩ ±10%, 1/2 w	01121	EB1221
S1	Switch, toggle, SPST	98095	ST-5
S2	Switch, toggle, DPDT	98095	ST-16
S3	Switch, rotary, DPST (part of R25)	98095	PS-5005R-12
T1	*Transformer, power	98095	TTM-58
	**Transformer, power	98095	TTM-TW5005-1

* Model 5005R only.
** Model TW5005 only.

CODE LIST OF MANUFACTURERS

Code No.	Manufacturer	Address
98095	Power Designs Inc.	Westbury, N.Y.
01121	Allen-Bradley Co.	Milwaukee, Wis.
16299	Corning Glass Works, Electronic Components Div.	Raleigh, N.C.
71400	Bussman Mfg. Division of McGraw Edison Co.	St. Louis, Mo.

ADDENDA

THE ELECTRICAL PARTS LIST IS MODIFIED AS FOLLOWS:

PAGE 5-3:

1. Diode CR11 is Part Number CD310C or DE410.
2. Transistors Q1 and Q2 are Part Number WS1700A.
3. Transistors Q4, Q7, Q8, Q11, Q13 and Q14 are Part Number MS2270/U or MS696.
4. Transistor Q9 is Part Number AS0697A or MS2270/U.
5. Note with triple asterisk (***) also refers to R6.
6. Last note (***) on page 5-3 should read: "If type CD310C is used R6 must be 150 Ω, 10%, 1/2 w, 01121 type EB1511."

PAGE 5-4:

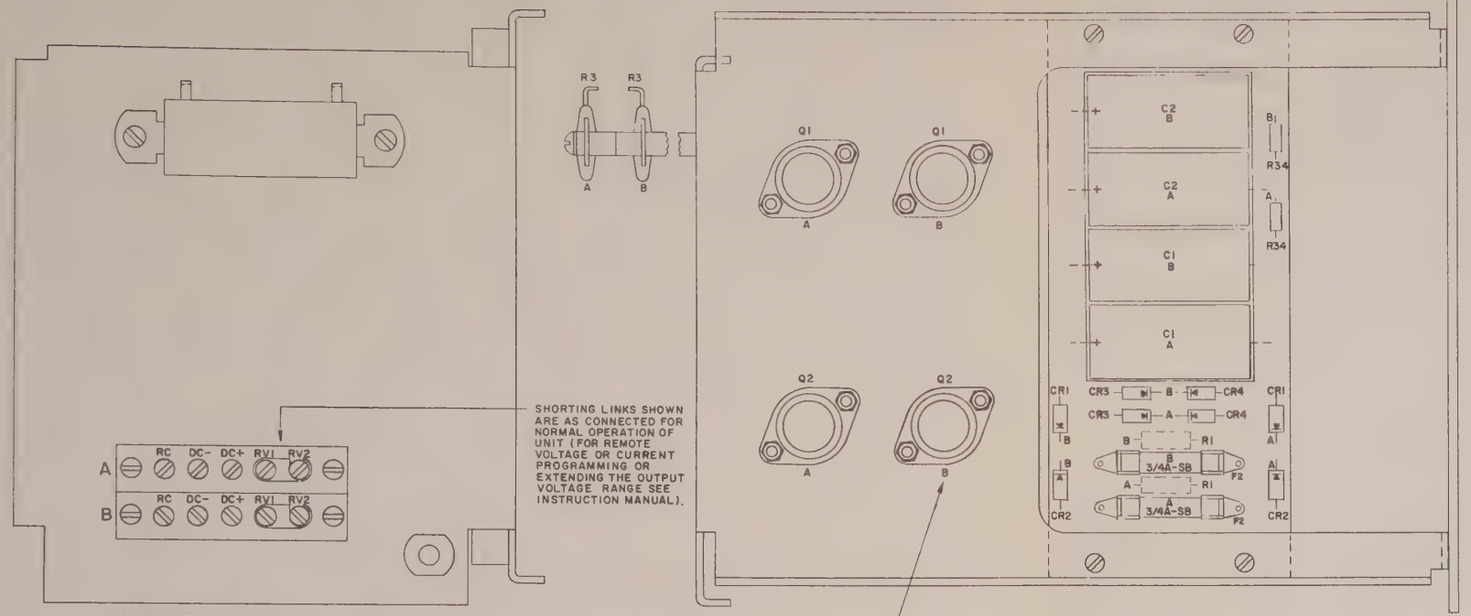
7. Resistor R8 is 150 Ω, 5%, 1/2 w, Part Number EB1515 (manufacturer 01121).
8. Resistor R12 is 510 Ω, 5%, 1/2 w, Part Number EB5115 (manufacturer 01121).
9. Resistor R23 is 1.5 kΩ, 5%, 1/2 w, Part Number EB1525 (manufacturer 01121).
10. Potentiometers R32 and R33 are concentric controls.

PAGE 5-5:

11. Resistor R49 is 1.5 kΩ, 10%, 1/2 w, Part Number EB1521 (manufacturer 01121).

THE SCHEMATIC DIAGRAMS OF MODELS 5005R AND TW5005 ARE MODIFIED AS FOLLOWS:

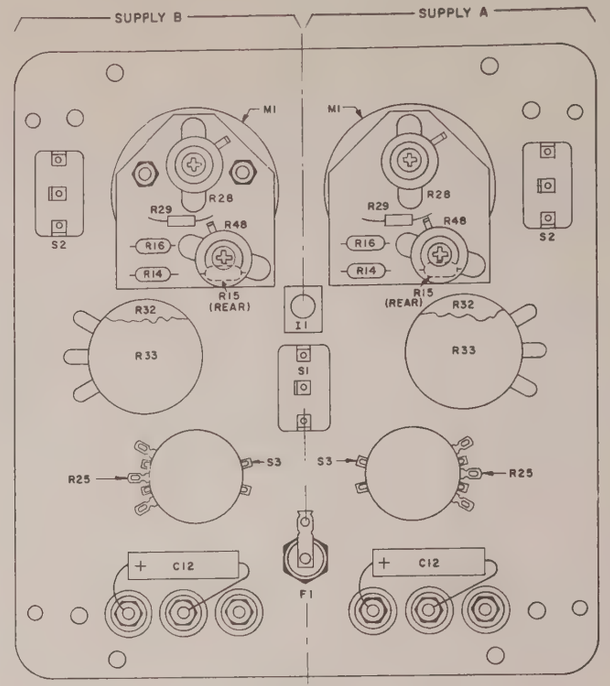
1. CR11 - When diode CR11 is a DE410 as shown on the schematic, resistor R6 is correctly shown as 220 Ω, 10%, 1/2 w. If CR11 is a CD310C, then R6 must be 150 Ω, 10%, 1/2 w.
2. Transistors Q1 and Q2 are Part Number WS1700A.
3. Transistors Q4, Q7, Q8, Q11, Q13 and Q14 are Part Number MS2270/U or MS696.
4. Transistor Q9 is Part Number AS0697A or MS2270/U.
5. Resistor R8 is 150 Ω, 5%, 1/2 w.
6. Resistor R12 is 510 Ω, 5%, 1/2 w.
7. Resistor R23 is 1.5 kΩ, 5%, 1/2 w.
8. Resistor R49 is 1.5 kΩ, 10%, 1/2 w.
9. On Drawing No. PS-TW5005-13, titled Location of Components, fuses A and B in the side view of the chassis assembly are 1 ampere Slo-Blo.



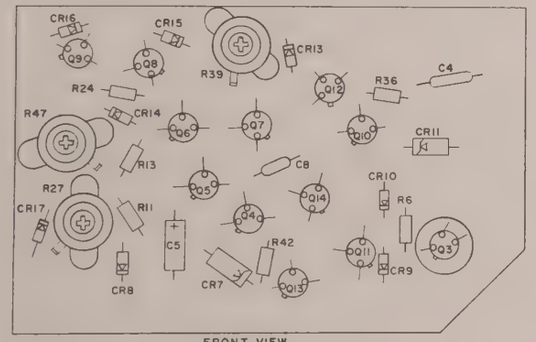
REAR VIEW OF CHASSIS ASSY

REFERENCE LETTERS SHOWN ADJACENT TO COMPONENTS INDICATE THE SUPPLY (A OR B) IN WHICH THEY FUNCTION.

SIDE VIEW OF CHASSIS ASSY

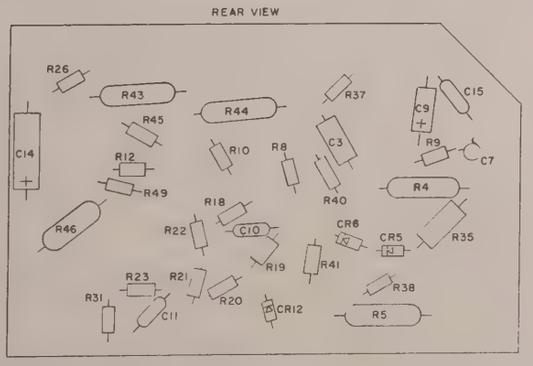


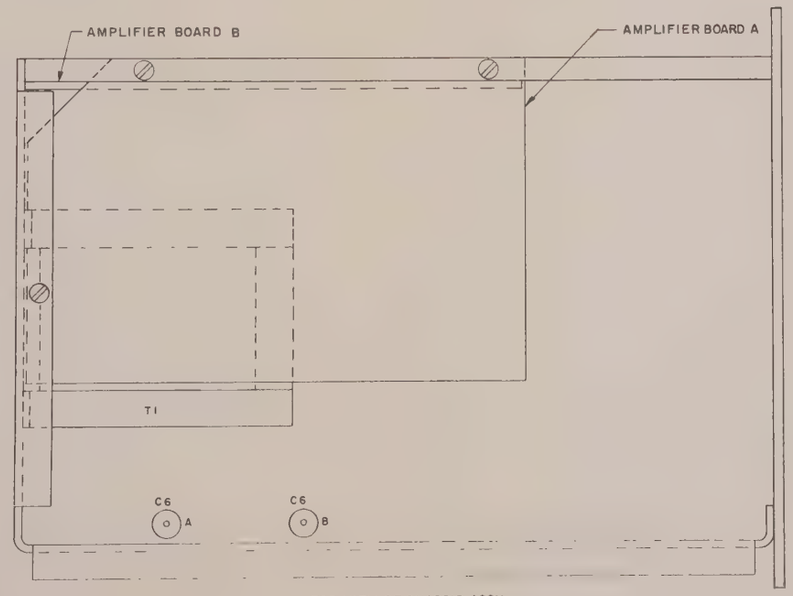
REAR OF PANEL ASSY



FRONT VIEW

AMPLIFIER BOARD ASSY





TOP VIEW OF CHASSIS ASSY

A	RELEASED		
SYM	DESCRIPTION	APP'D	DATE

REVISIONS

DRAWING NO. PS-TW5005-13 REV. A

TITLE LOCATION OF COMPONENTS, MOD. TW5005 TWIN POWER SUPPLY

DRAWN ET & RAS	CHECKED	APPROVED	
DATE 5-25-66	DATE 7-25-66	DATE	7-X-66

Power Designs Inc.
NEW YORK

ELECTRICAL SPECIFICATIONS

INPUT - 105–125 V, 57–440 Hz, 90 W*.

FRONT-PANEL OUTPUT TERMINALS – Three insulated binding posts are provided for each source to handle positive output, negative output, and chassis ground. The positive or negative output of either source may be grounded, or the source may be left floating.

REAR-PANEL OUTPUT TERMINALS – A separate phenolic terminal strip is provided for each source. Screw terminals are included for: positive output, negative output, remote voltage programming, and remote current programming.

OPERATING TEMPERATURE RANGE – 0–50°C.

CONSTANT VOLTAGE MODE (Each Source)

RANGE – 0–50 VDC, 0–500 MA, continuously adjustable.

SERIES OPERATION – 0–100 VDC, 0–500 MA, continuously adjustable.

PARALLEL OPERATION – 0–50 VDC, 0–1 AMP, continuously adjustable.

REGULATION – Better than 0.005% + 1 MV at front and rear access terminals for 100% change in rated load or line variations within operating range.

RIPPLE AND NOISE – Less than 1 millivolt peak-to-peak, 350 microvolts rms.

RESPONSE TIME – Less than 50 microseconds for step change (1-microsecond rise time) in rated load from 10 to 100% or from 100 to 10%.

SOURCE IMPEDANCE – Less than 0.01 ohm at DC, 0.1 ohm at 20KHz, 0.7 ohm at 1 MHz.

*at nominal line voltage.

STABILITY – Less than 0.02% + 10 MV drift per 24-hour period after warm-up, at fixed line, load, and ambient temperature, and with low TC programming resistance.

TEMPERATURE COEFFICIENT – Less than 0.02% per °C.

REMOTE PROGRAMMING RESISTANCE – 200 ohms/volt.

VOLTAGE CONTROL – Dual concentric fine and coarse adjustment with 5 MV resolution.

CONSTANT CURRENT MODE (Each Source)

RANGE – 0–500 MA, continuously adjustable.

PARALLEL OPERATION – 0–1 AMP, continuously adjustable.

VOLTAGE COMPLIANCE – 50 volts in single or parallel operation, 100 volts in series operation.

REGULATION – Output current change less than 500 microamps for line voltage change of ±10% or load variations down to a short circuit across the output terminals.

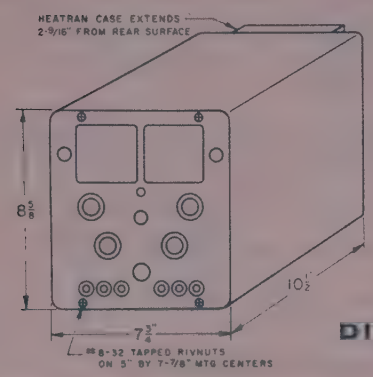
RIPPLE AND NOISE – Less than 300 microamps, peak-to-peak.

SOURCE IMPEDANCE – Greater than 100,000 ohms.

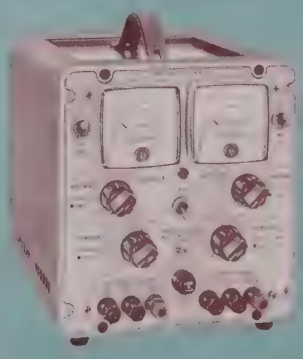
STABILITY – Less than 0.05% + 250 microamps drift per 24-hour period after warm-up, at fixed line, load, and ambient temperature, and with low TC programming resistance.

TEMPERATURE COEFFICIENT – 0.02% + 100 μA per °C.

CURRENT CONTROL – 0–50 MA and 0–500 MA, in two ranges with 0.25 MA resolution on 50 MA range and 2.5 MA resolution on 500 MA range.



DIMENSIONS



MECHANICAL SPECIFICATIONS

DIMENSIONS — 7¾" x 8⅝" x 13⅛" deep behind front panel.

WEIGHT — 17½ pounds.

FINISH — Panel is finished in brushed, natural aluminum with etched black lettering. Housing is finished in blue-gray vinyl enamel.

PRICE **$297.50**

FOB Westbury, N. Y.

POWER DESIGNS, INC.
1700 SHAMES DRIVE • WESTBURY, L. I., NEW YORK • 516 ED 3-6200 TWX: 510-222-6561

POWER DESIGNS PACIFIC, INC.
3381 JUNIPERO SERRA • PALO ALTO, CALIFORNIA • 415-321-8111 TWX: 910-373-1251

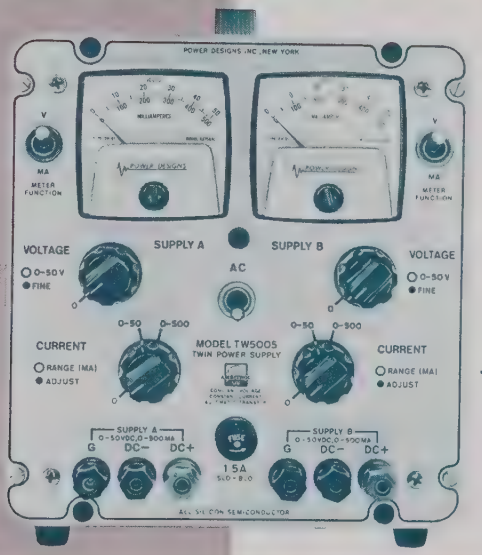
PRINTED IN U.S.A

POWER DESIGNS

TWIN DC POWER SOURCE

TECHNICAL DATA

MODEL TW5005



TWO INDEPENDENT SOURCES: 0–50 VOLTS, 0–500 MA. MAY BE OPERATED IN SERIES OR PARALLEL FOR 100-VOLT OR 1-AMPERE OUTPUT.

Each independent source in this general-purpose instrument can supply either a constant-voltage output with continuously adjustable current limiting or a constant-current output with continuously adjustable voltage compliance. The sources will automatically transfer from voltage regulation to current regulation or vice versa at any predetermined operating point.

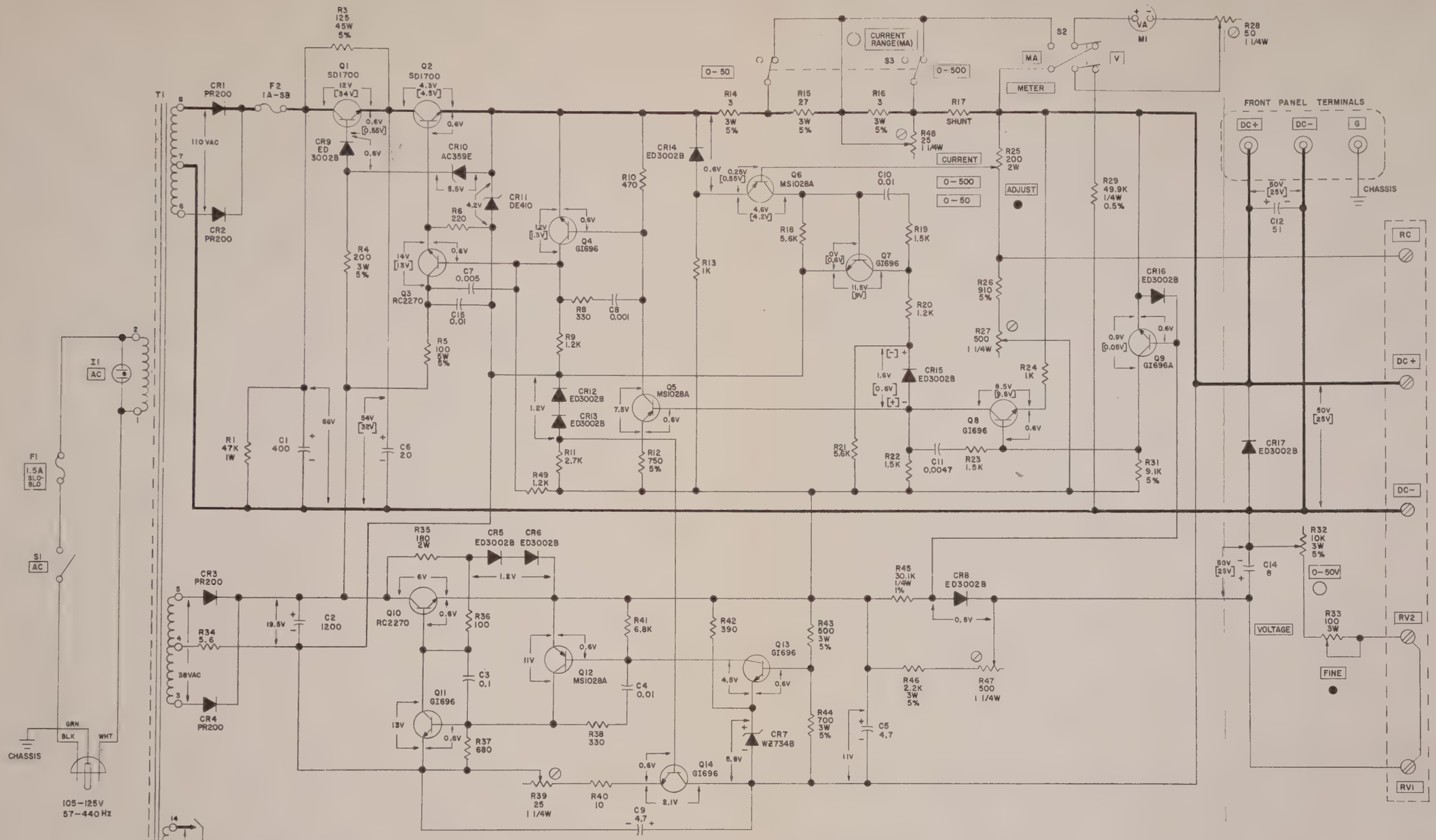
Each source has two current ranges, 50 or 500 MA. When the current range is switched, the current-limit adjustment and the meter range are automatically transferred.

The output voltage and current may be remotely programmed by the connection of an external resistance to a rear-panel terminal strip. This portable instrument is ideally suited for both field and laboratory use. Its design simplicity results in a versatile unit capable of years of trouble-free service.

DESIGN FEATURES

- Dual (coarse and fine) voltage controls with 5 MV resolution.
- Dual range output-current adjustment with 250 μA resolution.
- Self-restoring electronic overload and short-circuit protection.
- All silicon-semiconductor regulator system.
- Front and rear output terminals.
- Modular construction permits multiple-unit rack mounting. One or two (four power sources on a single panel) supplies may be mounted in a standard 8¾" x 19" rack. See catalog sheet RPA-62 for rack-panel adapters.
- Processed under Power Designs' "Predictable-Reliability" program for a 5-year MTBF. The program features: avalanche-controlled silicon rectifiers, stress-tested transistors, pre-aged zener references with extrapolated stability criteria based on 1/f noise changes, computer-grade capacitors, tin-oxide-film resistors, 5 PPM sealed divider resistors, and components operated at 50% of manufacturers' published ratings. Units pre-aged under full-load conditions for a minimum of 50 hours.

SERIAL NUMBER _____



UNLESS OTHERWISE SPECIFIED:

ALL RESISTORS ARE IN OHMS, 1/2W, 10%

ALL CAPACITORS ARE IN MICROFARADS

VOLTAGES INDICATED ARE MEASURED WITH 115VAC, 60Hz INPUT. MEASUREMENTS ARE MADE WITH A 20,000Ω / VOLT METER FOR DC AND 1000Ω / VOLT METER FOR AC. VOLTAGES ARE DC EXCEPT WHERE OTHERWISE INDICATED.

CONSTANT VOLTAGE MEASUREMENTS ARE MADE WITH 50VDC OUTPUT AND A 500MA LOAD. THE "CURRENT" CONTROL R25 IS SET TO MAXIMUM CLOCKWISE WITH S3 IN "0-500MA" POSITION.

CONSTANT CURRENT MEASUREMENTS ARE MADE WITH A 500MA OUTPUT INTO A 50Ω 50W LOAD. THE "VOLTAGE" CONTROLS R32 AND R33 ARE SET TO MAXIMUM CLOCKWISE POSITION WITH S3 IN "0-500MA" POSITION.

WHERE DUAL VOLTAGES ARE INDICATED, THOSE IN BRACKETS "[ ]" PERTAIN TO THE CONSTANT CURRENT MODE.

WHERE SINGLE VOLTAGES ARE INDICATED, THEY APPLY TO BOTH MODES OF OPERATION.

NOTE:

SUPPLY "A" SCHEMATIC IS SHOWN ABOVE. SUPPLY "B" SCHEMATIC IS IDENTICAL EXCEPT FOR TRANSFORMER SECONDARY CONNECTIONS, (TERMINALS 9,10,11 AND 12,13,14 ARE USED INSTEAD OF TERMINALS 3,4,5 AND 6,7,8).

REVISIONS			
STN	DESCRIPTION	APPD	DATE
A	RELEASED		
B	REVISED, ECN 1117.		
C	REVISED, ECN 1127		
D	REVISED, ECN 1137		
E	REVISED, ECN 1181.		
F	REV'D ECN 1189.		

DRAWING NO. PS-TW5005-12 REV F

TITLE SCHEMATIC, MOD. TW5005
TWIN PWR. SUP., 0-50VDC, 0-500MA

DRAWN C.G. | CHECKED | APPROVED

DATE 7-25-66 | DATE 7-25-66 | DATE 7-26-66

Power Designs Inc. NEW YORK

NOTICE

PATENTS HAVE BEEN GRANTED, PATENT APPLICATIONS ARE PENDING OR IN PROCESS OF PREPARATION ON THE PROPRIETARY PORTIONS OF THE CIRCUITS SHOWN ON THIS DRAWING. REPRODUCTION IN WHOLE OR IN PART MAY NOT BE MADE WITHOUT PERMISSION.

A D D E N D A

POWER SUPPLY

MODELS 5005R AND TW5005

THE FORMULA ON PAGE 2-3 OF THE MANUAL UNDER C OF PARAGRAPH 2-5 SHOULD READ:

$$R = \frac{215 \times 1}{540 - 1}$$

THE FORMULA ON PAGE 2-4 UNDER C OF PARAGRAPH 2-5 SHOULD READ:

$$R = \frac{215 \times 1}{54 - 1}$$

SALES OFFICES

Territory — ARKANSAS, LOUISIANA, OKLAHOMA & TEXAS

APPLIED SCIENCE ASSOCIATES

3707 Rawlins St., Dallas, Texas 75219	(214) 526-8316
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QED ELECTRONICS

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Territory — MARYLAND, DELAWARE, WASHINGTON, D.C., VIRGINIA

QED ELECTRONICS

880 Bonifant Street, Silver Springs, Md. 20910	(301) 588-8134

Territory — NEW YORK (N.)

R. J. C. ASSOCIATES

219 Oakridge Terrace, Liverpool, New York 13088	(315) 457-3220

Territory — NEW ENGLAND

HOWARD J. SCHUFT CO., INC.

815 Washington Street, Newtonville, Mass. 02160	(617) 527-5304 & 5

Territory — CONNECTICUT

HOWARD J. SCHUFT CO., INC.

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Territory — WASHINGTON, OREGON, IDAHO, MONTANA, ALASKA, BRITISH COLUMBIA

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Suite 21, 12A Finch Ave. West, Toronto, Ontario	(416) 223-4008

Territory — OVERSEAS

ROCKE INTERNATIONAL CORP.

13 East 40 Street, New York, New York 10016	(212) MU 9-0200

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WARRANTY

POWER DESIGNS INC., warrants to the original purchaser, each instrument sold by us, or our authorized agents, and all the parts thereof, to be free from defects in material or workmanship under normal use and service within the specified ratings and operating conditions.

Its obligation under this warranty is hereby limited to the repair or replacement of any instrument, or part thereof, which is returned to us within one year after delivery, and which shall prove, after our examination, to be thus defective.

This warranty does not include the cost of transportation charges to and from the factory and/or the cost of packaging or crating of instruments for return to the factory, unless such instrument is returned within thirty (30) days from the date of original shipment as shown on the packing list or shipping documents, and prior written authorization for such costs is obtained from the factory.

The repair or replacement of an instrument, or any part thereof, does not void or extend the original warranty.

POWER DESIGNS INC., reserves the right to discontinue any instrument without notice, or to make modifications in design at any time, without incurring any obligation to make these modifications in instruments previously sold.

POWER DESIGNS INC.
Westbury, L. I., New York

POWER DESIGNS PACIFIC, INC.
Palo Alto, California